

The Income Groups of Countries: An Approach of Management Information Systems via Networked Readiness Index

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Abstract

The main aim of this study is to utilize discriminant analysis to explain the relationship between the income groups, which was determined by the World Bank for 148 countries, and the Networked Readiness Index (NRI) values calculated for the same 148 countries given in the "Global Information Technology" report 2014, which is published by the World Economic Forum since 2001. In addition, it is aimed to put forward the administrative uses necessary to increase the income levels of countries through utilization of the NRI, which is a performance analysis on the use of information technologies in a country and hence is an index that comparatively measures the level of readiness of countries to use Information and Communication Technologies (ICTs), according to the findings obtained by comparing the NRI 2013 and NRI 2014 values of these countries. In this study, July 2014 World Bank Income groups (low income, lower middle income, upper middle income, high income:Non-OECD and high income:OECD) were used as the dependent variables, and 4 main Indicators of the NRI 2014 values, and 54 sub-index values were used as independent variables. The hypothesis of this study investigates whether the income groups of each country can be predicted by the components of the NRI index correctly. For this purpose, five different Fischer discriminant analyses were carried out by using the sub-indexes of the NRI both individually and in combination to calculate the extent which these components explain the income groups, and the results were presented in tables and graphs. In addition, the data analysis was supported with ANOVA, MANOVA and Post Hoc Tukey's test. The accuracy rate was found to be 94.0% in explaining the income groups of the countries when all sub-index values of the NRI were taken into account with the help of the discriminant functions which can be formed in accordance with the findings of the study. Among these groups, it explained the most of the variance in the High income:Non-OECD - High income:OECD - Low income group (100%), and the least of the variance in the Upper middle income group (88.2%). Considering the differences between the NRI 2014 and NRI 2013, the differences in the High income:OECD, high income:Non-OECD and upper middle income groups were statistically significant. The Territorial map created by the NRI 2014 values revealed that the Upper middle income group is located at the center. Besides other few methods, the NRI is a completely effective criterion for a country in this group to rise into the high income:OECD and high income:Non-OECD groups, which are the next upper economic groups. This map also helps to determine which income group rises or falls to which income groups when they increase or decrease their NRI values. And, the NRI values that converge or diverge the countries or the NRI values common among the countries in the income groups are determined with the help of a network graph created.

Keywords: Global Information Technology Report, management, Networked Readiness Index (NRI), income group, Information and Communication Technologies (ICTs), discriminant analysis, big data

1. Introduction

World Economic Forum published the 2014 values for the NRI, which is a performance analysis on the use of information technologies in a country and hence is an index published since 2001 that comparatively measures level of readiness of countries to use Information and Communication Technologies (ICTs). The Forum called the 2014 report as "The Global Information Technology Report 2014 Rewards and Risks of Big Data". The importance of the big data concept, which is used in the report title for the first time, was emphasized in the report thoroughly. And, we used the global NRI big data values in this study. When The Global Information Technology Report (GITR) and the Networked Readiness Index (NRI) were created more than 13 years ago, the attention of decision makers was focused on how to develop strategies that would allow them to benefit from what Time Magazine had described as "**the new economy**": a new way of organizing and managing economic activity based on the new opportunities that the Internet provided for businesses (Alexander 1983). For more than 13 years, the NRI has provided decision makers with a useful conceptual framework to evaluate the impact of ICT's at a global level and to benchmark the ICT readiness and usage of their economies (Bilbao-Osorio et al. 2014).

With innovations in the ICT technology moving at an amazing speed, almost on a monthly or even weekly basis new inventions are made and shared with the rest of the World through various avenues. People are the most important ones in new technologies that get to the market place. Customers are the ones who set the demand and consumption of the ICT products in the market place. This key point ensures that service delivery in government, which is (em)powered by technology, moves at an accelerated speed. (Gov-Tech 2014)

Today, all countries invest in information technologies most since it is known by everyone that only the countries which produce and use information efficiently will corner the world economy and the countries unable to perform this will fall behind. According to Susman & Santoz (2000:429), the information-based investments are for increasing "efficiency" and "effectiveness", and the main purpose of these investments is to accelerate the progress of these countries, as well as to increase their present welfare level.

And, the managers have to feel the conditions of organizations, make decisions and solve problems. As in every area, there have been certain changes in the management approach; and, the companies are not managed now as before. The managers now not only manage the current situation, but also recreate the organization with new products and services. The information technologies, which is one of the tools used by today's managers to deal with change, will play a significant role in creating and delivering new products and services, re-orientation and restructuring of the organizations by the managers (Laudon & Laudon 2010).

Smart phones, smart TVs and tablets are now not only a tool used for entertainment; instead they represent a new emerging computing platform today. Companies are adapting their software quickly to these smart mobile devices, and managers use these devices to coordinate the tasks, to communicate with employees, to make decisions and to manage the business.

Information flows and networks have spread across borders in ways that could not be imagined before the onset of the Internet, the global adoption of mobile telephony and social networks, and the rapid growth of broadband. Business models have been redefined, the workplace has been redesigned, small startups have evolved into large companies, and entire functions of society (education, health, security, privacy) are being rethought (Robert Crown Law Library Blog 2014).

The World Bank divides countries into several groups in their statistics and evaluations. The established main criterion is the Gross National Income (GNI) per capita. Based on the GNI, each country has been classified as the low income, middle income (divided into two, as the lower middle and upper middle) and high income (divided into two, as the High income:OECD and High income:Non-OECD) (Eksisozluk (2014).

2. Global Information Technology Report and the Networked Readiness Index

Definition of the Networked Readiness Index (NRI): Networked Readiness Index is published by the World Economic Forum since 2001. In 2014 the 14th edition of this index was published, which investigates the extent of readiness of countries to use information technologies, the extent of adoption of these technologies by individuals, businesses and public administration, and the transformative effects of these technologies on the economy and society. The number of countries changes each year in the report, and the report presents the NRI values and ranks of each country.

Developed by the Forum, the NRI also determines the level of participation of a country or a society in the developments in information technology. Since the NRI reveals also the strengths and weaknesses of a country with regard to informatics, it is also possible to follow competition between countries. The Networked Readiness Index (NRI) values and the rankings based on these values in the report show the social and economic impacts, as well as the impacts on countries' competitiveness caused by the information technologies. The NRI values, ranks and income groups of 30 prominent countries calculated for the 2014 are given in the following table-1:

Table 1 : NRI values are related in some countries values and ranks are as follows.

Rank	Country	Value	Income Group	Rank	Country	Value	Income Group
1	Finland	6.04	High income:OECD	17	Canada	5.41	High income:OECD
2	Singapore	5.97	Highincome:nonOECD	18	Australia	5.40	High income:OECD
3	Sweedeen	5.93	High income:OECD	20	New Zealand	5.27	High income:OECD
4	Netherland	5.79	High income:OECD	24	Un.Arab.Emir	5.20	Highincome:nonOECD
5	Norway	5.70	High income:OECD	25	France	5.09	High income:OECD
6	Switzerland	5.62	High income:OECD	32	Saudi Arabia	4.78	Highincome:nonOECD
7	United States	5.61	High income:OECD	34	Spain	4.69	High income:OECD
8	Hong Kong SAR	5.60	Highincome:nonOECD	50	Russian Fed.	4.30	Highincome:nonOECD
9	United Kingdom	5.54	High income:OECD	51	Turkey	4.30	Upper middle income
10	Korea Rep.	5.54	High income:OECD	58	Italy	4.18	High income:OECD
12	Germany	5.50	High income:OECD	62	China	4.05	Upper middle income
13	Denmark	5.50	High income:OECD	67	Thailand	4.01	Upper middle income
14	Taiwan, Chine	5.47	Highincome:nonOECD	83	India	3.85	Lower middle income
15	Israel	5.42	High income:OECD	100	Argentina	3,53	Upper middle income
16	Japan	5.41	High income:OECD	148	Chad	2,22	Low income

The report underlines the fact that there are limiting issues in the estimation of the index, therefore, while making comments regarding the position of countries and making comparisons, attention should be paid particularly to those social and economic peculiarities in countries like India, so as to reach proper interpretations (TUSIAD 2012)

Elements of the Networked Readiness Index: World Economic Forum uses 90 indicators and variables in the calculation of the NRI. These 90 indicators and variables are reduced to 54 variables and then to 10 sub-indexes of the NRI through a statistical analysis. The networked readiness framework translates into the NRI, comprising four sub-indexes that measure the environment for ICTs; the readiness of a society to use ICTs; the actual usage of all main stakeholders; and, finally, the impacts that ICTs generate in the economy and in society. The first three sub-indexes can be regarded as the drivers that establish the conditions for the results of the fourth sub-index, ICT impacts. NRI four main indexes: Environment Sub-index (A), Readiness Sub-index (B), Usage Sub-index (C) and Impact Sub-index (D). Information and Communication Technologies (ICTs) lead to positive developments in the organizations, management, productivity, and hence the welfare of countries. Regarding this positive impact, it is important to analyze and identify the position of countries accurately in terms of ICT indexes, which is an important factor for companies, and hence the countries, to achieve their targets by acquiring a sustainable competitive advantage. The final NRI score is a simple average of the four sub-index scores, while each of the 54 sub-factor's score is a simple average of those of the composing pillars.

Calculation of the NRI: World Economic Forum uses two types of data in the calculation of the NRI. The first of these is the data set obtained from the Executive Opinion Survey prepared for the Global Competitiveness Report, and the latter is the data obtained from international institutions such as the World Bank and the International Telecommunication Union (ITU). In the report, the use of the findings obtained from the global competitiveness report indicates the importance of ICTs for competition. In the calculation of the index, the data are scored first by a 7-point scale to ensure equal distribution of each part. Then each sub-index is calculated by taking the weighted average of the related data. And, the index of the components is calculated through the same method by taking averages of the sub-indexes. Finally, the NRI is calculated by taking the average of the indexes of the four components. The NRI indices are given in the following table-2.

Table -2 : The Networked Readiness Index 2014

Environment subindex 1/2 Political and regulatory environment 1/2 Business and innovation environment	1st pillar: Political and regulatory environment	1.01 Effectiveness of law-making bodies* 1.02 Laws relating to ICTs* 1.03 Judicial independence* 1.04 Efficiency of legal system in settling disputes* 1.05 Efficiency of legal system in challenging regulations* 1.06 Intellectual property protection* 1.07 Software piracy rate, % software installed 1.08 Number of procedures to enforce a contractd 1.09 Number of days to enforce a contract
	2nd pillar: Business and innovation environment	2.01 Availability of latest technologies* 2.02 Venture capital availability* 2.03 Total tax rate, % profits 2.04 Number of days to start a business 2.05 Number of procedures to start a business 2.06 Intensity of local competition* 2.07 Tertiary education gross enrollment rate, % 2.08 Quality of management schools* 2.09 Government procurement of advanced technology products*
Readiness subindex 1/3 Infrastructure and digital content 1/3 Affordability 1/3 Skills	3rd pillar: Infrastructure and digital content	3.01 Electricity production, kWh/capita 3.02 Mobile network coverage, % population 3.03 International Internet bandwidth, kb/s per user 3.04 Secure Internet servers per million population 3.05 Accessibility of digital content*
	4th pillar: Affordability	4.01 Mobile cellular tariffs, PPP \$/min. 4.02 Fixed broadband Internet tariffs, PPP \$/month 4.03 Internet and telephony sectors competition index, 0–2 (best)
	5th pillar: Skills	5.01 Quality of educational system* 5.02 Quality of math and science education* 5.03 Secondary education gross enrollment rate, % 5.04 Adult literacy rate, %
Usage subindex 1/3 Individual usage 1/3 Business usage 1/3 Government usage	6th pillar: Individual usage	6.01 Mobile phone subscriptions per 100 population 6.02 Percentage of individuals using the Internet 6.03 Percentage of households with computer 6.04 Households with Internet access, % 6.05 Fixed broadband Internet subscriptions per 100 population 6.06 Mobile broadband Internet subscriptions per 100 population 6.07 Use of virtual social networks*
	7th pillar: Business usage	7.01 Firm-level technology absorption* 7.02 Capacity for innovation* 7.03 PCT patent applications per million population 7.04 Business-to-business Internet use*g 7.05 Business-to-consumer Internet use*g 7.06 Extent of staff training*
	8th pillar: Government usage	8.01 Importance of ICTs to government vision of the future* 8.02 Government Online Service Index, 0–1 (best) 8.03 Government success in ICT promotion*
Impact subindex 1/2 Economic impacts 1/2 Social impacts	9th pillar: Economic impacts	9.01 Impact of ICTs on new services and products* 9.02 PCT ICT patent applications per million population 9.03 Impact of ICTs on new organizational models* 9.04 Employment in knowledge-intensive activities, % Workforce
	10th pillar: Social impacts	10.01 Impact of ICTs on access to basic services* 10.02 Internet access in schools* 10.03 ICT use and government efficiency* 10.04 E-Participation Index, 0–1 (best)

3. Materials And Methods

In this study, July 2014 World Bank Income groups (low income, lower middle income, upper middle income, high income:Non-OECD and high income:OECD) were used as the dependent variables; and 4 main indicators (A, B, C, D) from the NRI 2014 values, and 54 sub-index values were used as independent variables. The hypothesis of this study investigates whether the income groups of each country can be predicted by the components of the NRI index correctly. For this purpose, five different Fischer discriminant analyses were performed by using the sub-components of the NRI individually and in combination to calculate the extent that these components explain the income groups, and the results were presented in tables and graphs. In addition, the data analysis was supported with ANOVA, MANOVA and Post Hoc Tukey's test.

The Discriminant Analysis was first used in 1930 and is still used in various fields. First, it was used in the behavioral sciences and biology, and later it was started to be used also in the solution of financial problems (such as consumer loan assessment).

Discriminant analysis is a statistical technique used to classify observations into one of several a priori groups, depending on their individual characteristics (Altman 1965). It finds the dimension(s) that maximize the difference between groups and determines the group memberships based on the differences of the independent variables used (Alpar 2011). Particularly, it is used for classification or forecasting when the dependent variable consists of attributes, such as male/female or bankruptcy/non-bankruptcy. As a first step, it is necessary to know the groups in advance. Variables with two or more groups can be included in the study. The discriminant analysis tries to obtain the best discriminants between the groups with the help of linear combinations after creating the groups. For example, discriminant coefficients can be set by all measurable features of a company (financial ratios). These coefficients form a basis for mutually exclusive groups, when they are applied to the original rates (Altman 1965).

We used the accuracy rates to explain the effectiveness of the questions that form the NRI in differentiating the income groups, by assigning these groups as the dependent variable in our study. According to these results, the accuracy rate in explaining the income groups was found to be 94.0%, considering all the sub-groups that form the NRI index. Among these groups, High income:Non-OECD - High income:OECD - Low income groups were found to be explained most (100%), and the Upper middle income group was found to be explained least (88.2%). Looking at the individual criteria, the "Skills" criterion (5th criterion) has the highest accuracy rate (60.8%) in explaining the income groups. Among these groups, it explained the most of the variance in the High income:OECD (96.8%) group and the least of the variance in the Lower middle income (28.6%) group. If we group the criteria, the "Readiness sub-index: 1/3 infrastructure and digital content + 1/3 affordability + 1/3 skills" criteria (B3-B4-B5 criteria) have the highest accuracy rate (63.3%) in explaining the income groups. Among these groups, it explained the most of the variance in the Low income group (82.6%) and the least of the variance in the Lower middle income group (34.3%).

4. Research Methodology

The purpose of this study is to investigate the relationship between July 2014 World Bank Country Income groups and the NRI index values published in the World Economic Forum Global Information Technology Report 2014, and the extent that these values explain the country income-levels and whether this index accurately predicts the income groups of countries. In the study, it is tried to determine the predictive power of the NRI in the income groups and its success in differentiating the income groups. In addition, the differences between income groups were evaluated in terms of the NRI 2014 and NRI 2013 values.

In this study, the paired t-test was used to compare the means of two groups depending on the NRI 2014 and NRI 2013 index values for each group separately. One-way analysis of variance (ANOVA) was applied to the differences between the groups for each sub-item of the NRI index. A post Hoc evaluation was performed with Tukey's test. The Multiple Analysis of Variance (MANOVA) was applied to find the overall difference between groups by using a combination of all sub-items of the NRI index.

Two data sets were used in this study. The first data set was the 10 sub-indexes and the values of its 54 variables from the Networked Readiness Index created by the World Economic Forum for 148 countries in 2013 and 2014. The second data set consists of the World Bank income group values of these 148 NRI countries in July 2014. The income-group values are divided into low income, lower middle income, upper middle income, high income:Non-OECD and high income:OECD groups.

In the study, the multivariate discriminant analysis, which is a conceptually and mathematically powerful

statistics method, was used. The discriminant analysis has two main goals of discrimination and classification (Özdamar, 1999:320), and it estimates the class membership of the independent variables (Johnson, 1988,217).

Discriminant analysis is used to classify individuals or entities by using discriminant prediction-equation (function), to test theories about the classification of individuals or entities based on the estimates, to investigate the differences between the groups, to determine the most conservative way of differentiating the groups, to determine the variance in the dependent variables explained by the independent variables, to assess the relative importance of the independent variables in a classification based on dependent variables, to eliminate insignificant variables or the variables with little importance in differentiating the groups, and so on (Büyükoztürk Ş. & Bökeoğlu, Ö.Ç. 2014).

Discriminant analysis also reveals the estimate variables effective in the differences between the groups. In addition, it identifies the exact group of an entity, which its groups are unknown (Ünsal, 2000).

Acknowledgment

Multivariate data analysis of this study was carried out by a professional consulting service (<http://www.mestacon.info/> <http://turkey.mestacon.com/>). The service cost was paid by the researcher without any project support or financial support.

Limitations

The NRI-2014 index has a total of 118 values for each of the 148 countries. These values consist of four main indicators, 54 sub-indexes and 59 rank values that indicate the order of these values among the countries. One of the factors in calling the report as a big data is its excessive amount of data. It was not possible to interpret the whole lot of data in this article. However, tables and graphs will help readers to draw their own conclusions.

5. Results

The findings we obtained by applying the Discriminant analysis in order to see the criterion with best predictive power among the factors of the NRI are given in Table-3. In the table, each criterion was examined separately in terms of its individual factors and the group(s), which these factors explained the most and the least of the variance were presented together with their accuracy rates.

Table 3 : According to the results of discriminant analysis occurary% of the criteria in the model

Criteria	Accuracy rate	Highest group	Highest group (%)	Lowest group	Lowest group (%)
1	65,1	High income: OECD	87,1	Upper middle income	32,4
2	60,1	Low income	91,3	High income: nonOECD- Lower middle income	40
3	55,5	Low income	100	Lower middle income	0
4	32,4	High income: OECD	90,3	Upper middle income	7,7
5	60,8	High income: OECD	96,8	Lower middle income	28,6
6	68	Low income	100	High income: nonOECD	55
7	45,2	Low income	95,7	High income: nonOECD	0
8	43,8	Low income	69,6	Lower middle income	14,3
9	58,8	Low income	93,8	Lower middle income	43,3
10	54,5	Low income	77,3	Lower middle income	34,3
A1-A2	52,7	Low income	69,6	Lower middle income	42,9
B3-B4-B5	63,3	Low income	82,6	Lower middle income	34,3
C6-C7-C8	62,8	Low income	91,3	Lower middle income	42,9

D9-D10	49,3	Low income	73,9	Lower middle income	22,9
A-B-C-D	58,8	Low income	69,6	High income: nonOECD	45
All sub Groups	94	High income: nonOECD- High income: OECD- Low income	100	Upper middle income	88,2

Given the political and regulatory environment criterion (criterion 1), the accuracy rate in explaining the income groups was found to be 65.1%. Among these groups, it explained the most of the variance in the High income:OECD group (87.1%) and the least of the variance in the Upper middle income group (32.4%).

Considering the business and innovation environment (criterion 2), the accuracy rate in explaining the income groups was found to be 60.1%. Among these groups, it explained the most of the variance in the Low income group (91.3%) and the least of the variance in the High income:Non-OECD and Lower middle income groups (40.0%).

Given the infrastructure and digital content criterion (criterion 3), the accuracy rate in explaining the income groups was found to be 55.5%. Among these groups, it explained the most of the variance in the Low income group (100%) and the least of the variance in the Lower middle income group (0.0%).

Given the affordability criterion (criterion 4), the accuracy rate in explaining the income groups was found to be 32.4%. Among these groups, it explained the most of the variance in the High income:OECD group (90.3%) and the least of the variance in the Upper middle income group (7.7%).

Considering the skills-criterion (criterion 5), the accuracy rate in explaining the income groups was found to be 60.8%. Among these groups, it explained the most of the variance in the High income:OECD (96.8%) group and the least of the variance in the Lower middle income (28.6%) group.

Considering the individual usage criterion (criterion 6), the accuracy rate in explaining the income groups was found to be 68.0%. Among these groups, it explained the most of the variance in the Low income group (100%) and the least of the variance in the High income:Non-OECD group (55.0%).

Given the business usage criterion (criterion 7), the accuracy rate in explaining the income groups was found to be 45.2%. Among these groups, it explained the most of the variance in the Low income group (95.7%) and the least of the variance in the High income:Non-OECD group (0.0%).

Given the governmental usage criterion (criterion 8), the accuracy rate in explaining the income groups was found to be 43.8%. Among these groups, it explained the most of the variance in the Low income group (69.6%) and the least of the variance in the Lower middle income group (14.3%).

Given the economic impacts criterion (criterion 9), the accuracy rate in explaining the income groups was found to be 58.8%. Among these groups, it explained the most of the variance in the Low income group (93.8%) and the least of the variance in the Lower middle income group (43.3%).

And, given the social impacts criterion (criterion 10), the accuracy rate in explaining the income groups was found to be 54.5%. Among these groups, it explained the most of the variance in the Low income group (77.3%) and the least of the variance in the Lower middle income group (34.3%).

Environment sub-index: Looking at the 1/2 political and regulatory environment + 1/2 business and innovation environment criteria (A1-A2 criteria), the accuracy rate in explaining the income groups was found to be 52.7%. Among these groups, it explained the most of the variance in the Low income group (69.6%) and the least of the variance in the Lower middle income group (42.9%).

Readiness sub-index: Given the 1/3 infrastructure and digital content + 1/3 affordability + 1/3 skills criteria (B3-B4-B5 criteria), the accuracy rate in explaining the income groups was found to be 63.3%. Among these groups, it explained the most of the variance in the Low income group (82.6%) and the least of the variance in the Lower middle income group (34.3%).

Usage sub-index: Looking at the 1/3 individual usage + 1/3 business usage + 1/3 governmental usage criteria (C6-C7-C8 criteria), the accuracy rate in explaining the income groups was found to be 62.8%. Among these groups, it explained the most of the variance in the Low income group (91.3%) and the least of the variance in the Lower middle income group (42.9%).

Impacts sub-index: Considering the 1/2 economic impacts + 1/2 social impacts criteria (D9-D10 criteria), the

accuracy rate in explaining the income groups was found to be 49.3%. Among these groups, it explained the most of the variance in the Low income group (73.9%) and the least of the variance in the Lower middle income group (22.9%).

Given the NRI's A-B-C-D criteria, the accuracy rate in explaining the income groups was found to be 58.8%. Among these groups, it explained the most of the variance in the Low income group (69.6%) and the least of the variance in the High income:Non-OECD group (45.0%).

Considering all subgroups, the accuracy rate in explaining the income groups was found to be 94.0%. Among these groups, High income:Non-OECD - High income:OECD - Low income groups were found to be explained most (100%), and the Upper middle income group was found to be explained least (88.2%).

Estimated places and placement probabilities of the countries according to the discriminant analysis results are given in Table-4.

Table 4. Estimated places and placement probabilities of the countries according to the discriminant analysis results

Country	Actual Group	Highest Group					Second Highest Group			Discriminant Scores			
		Predicted Group	P(D>d G=g)		P(G=g D=d)	Squared Mahalanobis Distance to Centroid	Group	P(G=g D=d)	Squared Mahalanobis Distance to Centroid	Function 1	Function 2	Function 3	Function 4
			p	df									
1	1	1	,293	4	1,000	4,949	5	,000	36,571	2,057	-3,737	-3,633	-1,220
2	1	1	,465	4	1,000	3,585	5	,000	41,304	1,684	-1,801	-4,610	1,081
3	1	1	,607	4	1,000	2,715	5	,000	24,991	2,158	-2,849	-2,624	-1,092
4	1	1	,349	4	,981	4,443	5	,019	12,328	,201	-1,326	-2,230	,250
5	1	1	,702	4	1,000	2,184	5	,000	25,262	,486	-2,259	-3,523	,555
6	1	1	,832	4	1,000	1,470	2	,000	32,789	2,916	-2,223	-3,341	,113
8	1	1	,204	4	,997	5,933	2	,003	17,784	2,965	-1,844	-,980	1,077
9	1	1	,112	4	,716	7,491	5	,284	9,341	1,216	-,621	-1,496	-,873
10	1	1	,554	4	1,000	3,021	5	,000	39,591	2,495	-3,496	-2,717	1,615
11	1	1	,684	4	1,000	2,284	5	,000	21,414	1,055	-3,156	-1,951	,823
13	1	1	,626	4	1,000	2,607	5	,000	37,906	1,757	-3,220	-3,146	1,828
14	1	1	,289	4	,941	4,980	5	,059	10,533	,500	-1,486	-1,439	,563
15	1	1	,862	4	1,000	1,294	5	,000	36,332	1,820	-2,407	-4,083	,561
16	1	1	,202	4	1,000	5,965	2	,000	41,241	3,080	-1,508	-4,798	,820
19	1	1	,379	4	1,000	4,206	5	,000	45,510	1,885	-4,067	-3,648	1,457
20	1	1	,587	4	1,000	2,830	5	,000	34,834	3,053	-2,912	-3,026	-,618
21	2	2	,915	4	1,000	,964	1	,000	42,542	5,030	1,655	,937	1,130
22	2	2	,955	4	1,000	,670	1	,000	32,365	4,562	,853	,786	,049
23	2	2	,919	4	1,000	,937	1	,000	32,127	5,213	,600	,359	-,303
24	2	2	,800	4	1,000	1,647	1	,000	24,288	4,375	,697	-,166	-,089
25	2	2	,034	4	,960	10,416	5	,031	17,264	3,191	-,887	,719	-1,005
26	2	2	,204	4	,998	5,936	5	,002	18,280	2,895	,628	1,119	-,042
27	2	2	,509	4	1,000	3,297	1	,000	48,058	6,888	1,044	,256	,085
28	2	2	,146	4	,981	6,820	1	,019	14,744	4,388	-,712	-,720	,958
29	2	2	,705	4	1,000	2,168	1	,000	41,394	5,123	2,199	-,062	1,310
30	2	2	,843	4	1,000	1,405	1	,000	38,385	5,932	1,293	-,228	-,099
31	2	2	,473	4	1,000	3,532	5	,000	56,956	5,286	2,744	1,498	1,087
32	2	2	,820	4	1,000	1,540	1	,000	35,867	5,779	,474	,408	-,310

33	2	2	,832	4	1,000	1,472	1	,000	48,241	5,804	1,649	,958	1,163
34	2	2	,930	4	1,000	,863	1	,000	48,530	5,659	1,766	1,075	,652
35	2	2	,104	4	1,000	7,684	5	,000	50,413	5,531	,194	3,039	,057
36	2	2	,466	4	1,000	3,581	5	,000	55,960	5,692	2,404	1,870	-,340
37	2	2	,918	4	1,000	,943	1	,000	36,474	5,397	,528	,919	,589
38	2	2	,587	4	1,000	2,830	1	,000	54,002	5,359	2,970	,536	-,033
39	2	2	,991	4	1,000	,279	1	,000	36,133	5,090	1,307	,426	,800
40	2	2	,295	4	1,000	4,922	1	,000	56,668	6,021	1,141	2,029	1,677
41	2	2	,721	4	1,000	2,079	1	,000	34,048	5,733	1,112	-,571	-,343
42	2	2	,720	4	1,000	2,088	1	,000	52,682	6,469	1,845	,622	,097
43	2	2	,205	4	,994	5,917	1	,006	16,113	3,547	-,133	-,286	-,446
44	2	2	,485	4	1,000	3,451	1	,000	18,825	3,867	,498	-,485	,545
46	2	2	,710	4	1,000	2,142	1	,000	42,967	4,945	2,604	-,146	,224
47	2	2	,399	4	1,000	4,053	1	,000	29,420	4,076	1,665	-,572	-,957
48	2	2	,094	4	1,000	7,946	1	,000	69,160	5,998	3,852	,469	1,213
49	2	2	,446	4	1,000	3,712	5	,000	50,553	4,683	2,545	1,220	1,557
50	2	2	,550	4	1,000	3,047	1	,000	40,433	5,610	1,889	-,539	-,857
51	2	2	,909	4	1,000	1,003	1	,000	49,774	5,850	1,626	1,190	,331
52	3	3	,272	4	,999	5,154	4	,001	18,594	-4,880	2,849	-,478	,509
53	3	3	,101	4	,996	7,748	4	,004	18,728	-4,828	3,001	-,325	1,498
54	3	3	,877	4	1,000	1,205	4	,000	49,584	-6,472	4,158	-2,539	-,036
55	3	3	,289	4	1,000	4,986	4	,000	63,235	-6,520	4,816	-2,533	-1,674
56	3	3	,496	4	1,000	3,385	4	,000	34,206	-5,829	1,948	-2,995	-,382
57	3	3	,896	4	1,000	1,091	4	,000	41,991	-5,166	4,377	-1,878	-,428
58	3	3	,484	4	1,000	3,460	4	,000	47,591	-4,744	3,102	-4,010	-,338
59	3	3	,851	4	1,000	1,362	4	,000	50,612	-6,501	4,250	-2,495	-,154
60	3	3	,348	4	1,000	4,457	4	,000	68,493	-5,481	5,240	-3,761	-,412
61	3	3	,313	4	1,000	4,755	4	,000	46,344	-4,654	3,363	-3,927	1,231
74	3	3	,876	4	1,000	1,215	4	,000	30,494	-5,550	2,938	-1,747	-,580
75	4	4	,531	4	1,000	3,165	5	,000	19,338	-3,010	-1,929	1,090	2,325
76	4	4	,614	4	1,000	2,674	5	,000	20,318	-3,827	,236	,464	2,030
77	4	5**	,630	4	,857	2,582	4	,143	6,167	-2,015	-,271	,093	-,310
78	4	4	,483	4	1,000	3,465	5	,000	26,841	-4,786	-,260	,638	2,140
79	4	4	,714	4	,905	2,121	5	,095	6,633	-2,560	-,692	1,963	,176
80	4	4	,380	4	1,000	4,198	5	,000	24,009	-5,279	-,835	,431	,958
81	4	4	,654	4	,996	2,448	5	,004	13,715	-3,074	-2,124	,866	1,328
82	4	4	,684	4	1,000	2,280	5	,000	24,410	-3,790	-,992	1,993	2,470
83	4	5**	,010	4	,847	13,252	4	,153	16,678	-2,217	-2,252	3,619	-1,641
84	4	4	,897	4	,999	1,082	5	,001	15,122	-3,486	,292	1,333	1,378
85	4	4	,901	4	,997	1,056	5	,003	12,662	-3,287	-1,721	1,397	1,021
86	4	4	,526	4	,990	3,194	5	,010	12,440	-4,087	,218	1,436	-,249
87	4	4	,885	4	1,000	1,159	5	,000	19,861	-3,529	-,997	1,790	2,107
88	4	4	,207	4	1,000	5,891	5	,000	24,585	-2,444	-,172	1,895	3,210
89	4	4	,963	4	,978	,602	5	,022	8,147	-2,864	-,714	1,227	,709
94	4	4	,751	4	,973	1,917	5	,027	9,066	-3,482	-1,044	,393	,245
96	4	5**	,257	4	,514	5,307	4	,486	5,419	-2,771	-,155	-,198	-,290
97	4	4	,173	4	1,000	6,377	5	,000	25,251	-4,894	,784	2,695	,494
99	4	4	,144	4	1,000	6,858	3	,000	22,248	-4,379	,871	,128	2,534

100	4	4	,887	4	,999	1,143	5	,001	15,740	-3,614	-,046	2,209	1,077
101	4	4	,268	4	,992	5,194	5	,008	14,935	-3,063	-2,663	2,337	,555
103	4	4	,972	4	,994	,513	5	,006	10,824	-3,501	-1,041	1,510	,518
106	4	4	,537	4	,953	3,127	5	,047	9,129	-1,944	-1,129	2,155	1,043
107	4	4	,801	4	1,000	1,641	5	,000	18,655	-3,476	-1,246	,767	2,133
108	4	4	,386	4	1,000	4,151	5	,000	30,610	-4,565	-1,025	1,119	2,824
109	4	4	,376	4	1,000	4,231	5	,000	24,623	-4,609	,187	2,851	1,032
110	5	5	,241	4	1,000	5,490	4	,000	29,177	-,161	-,569	1,951	-3,073
111	5	5	,425	4	,957	3,859	4	,043	10,060	-2,561	-1,467	1,229	-1,790
112	5	5	,055	4	,927	9,253	4	,059	14,776	-3,056	1,085	-,692	-1,498
113	5	5	,122	4	1,000	7,267	1	,000	28,222	,100	-2,580	,819	-2,879
114	5	5	,588	4	,997	2,821	4	,003	14,295	-2,249	-,716	,731	-2,366
115	5	5	,439	4	1,000	3,763	4	,000	19,195	-1,432	-1,778	1,446	-2,577
116	5	4**	,702	4	,788	2,184	5	,212	4,804	-2,410	-,547	,869	,293
117	5	5	,008	4	1,000	13,709	2	,000	30,167	1,004	1,649	-,417	-3,185
118	5	5	,755	4	,999	1,895	1	,001	16,520	,240	-,886	,228	-,781
119	5	5	,295	4	,712	4,927	4	,288	6,740	-2,383	-1,521	-,344	-,223
120	5	5	,395	4	,999	4,080	4	,001	18,652	-,410	,453	2,203	-1,532
121	5	5	,547	4	,998	3,063	4	,001	16,655	,090	-,156	,013	-,145
122	5	4**	,702	4	,941	2,184	5	,059	7,717	-2,667	-,567	2,177	,209
123	5	4**	,167	4	,580	6,460	5	,420	7,104	-1,370	-2,083	1,219	,817
124	5	5	,031	4	1,000	10,599	4	,000	30,714	-2,287	,288	-1,049	-3,576
125	5	1**	,095	4	,911	7,909	5	,071	13,000	1,981	-,411	-1,075	-,089
126	5	5	,891	4	,992	1,123	4	,008	10,745	-1,434	,219	,927	-1,187
127	5	5	,627	4	,918	2,597	4	,082	7,426	-1,149	,074	,987	,057
129	5	5	,604	4	,995	2,733	1	,005	13,461	-,359	-1,380	-,743	-1,199
130	5	5	,701	4	,999	2,188	4	,001	16,732	-1,137	-1,391	-,647	-1,426
132	5	5	,544	4	,998	3,085	1	,001	16,160	,366	-1,351	,538	-,376
133	5	5	,664	4	1,000	2,391	4	,000	20,403	-1,066	-1,739	,190	-2,329
134	5	5	,970	4	1,000	,537	4	,000	16,233	-,677	-1,184	,885	-1,661
135	5	5	,346	4	,997	4,473	4	,003	15,911	-,575	,786	2,089	-1,022
136	5	5	,494	4	,996	3,392	4	,004	14,658	-1,050	-2,483	,808	-1,154
138	5	5	,350	4	,970	4,438	1	,030	11,407	-,495	-1,262	-1,316	-,958
139	5	5	,621	4	,933	2,633	4	,067	7,901	-2,236	,248	,447	-,979
140	5	5	,835	4	,993	1,455	4	,007	11,357	-1,251	-1,023	1,729	-1,337
142	5	5	,585	4	,997	2,840	1	,002	15,316	,190	-,539	-,028	-,258
143	5	5	,256	4	1,000	5,318	4	,000	25,488	,384	,084	2,257	-1,877
145	5	5	,862	4	,983	1,295	4	,017	9,385	-1,339	-1,567	,753	-,767
146	5	5	,867	4	,961	1,269	4	,039	7,688	-2,000	-,366	,712	-1,067
147	5	5	,462	4	1,000	3,609	2	,000	22,945	,813	-,006	,910	-1,245
148	5	5	,171	4	1,000	6,407	4	,000	26,297	-1,559	,227	1,271	-3,510

Since the highest rate was found in the combination of the sub-groups according to the accuracy rate result of discriminant analysis, a territorial map (Figure 1) was created based on this combination-group to examine the mutual proximity of groups.



Figure 1 : Income group Territorial Map (Assuming all functions but the first two are zero)
(Canonical Discriminant, Function 2)

Figure 1 Symbol and Group Label : 1- High income: nonOECD, 2- High income: OECD, 3- Low income, 4- Lower middle income, 5- Upper middle income, *- Indicates a group centroid

According to the territorial map, the Upper middle income group is located at the center of the graph and has borders with all the groups. It is also seen in the graph that the Upper middle income group is located on the same ring with the overall mean. In the light of these graphical information, ANOVA and post hoc Tukey's test was used in order to determine the direction --be it either towards the upper or lower income group-- of an average country, i.e. a country in the Upper middle income group, in the territorial map when its NRI value is changed. Test results are given in Table 5. According to these test results:

Table 5. Territorial map results

Territorial map finding results NRI index	High Income OECD	High Income nonOECD	Lower Middle Income	Low Income
1.01 Effectiveness of law-making bodies*	+	+	-	-
1.02 Laws relating to ICTs*	+	+	-	+
1.03 Judicial independence*	+	+	-	-
1.04 Efficiency of legal system in settling disputes*	+	+	-	-
1.05 Efficiency of legal system in challenging regulations*	+	+	-	-
1.06 Intellectual property protection*	+	+	-	-
1.07 Software piracy rate, % software installed	+	-	-	+
1.08 Number of procedures to enforce a contractd	+	-	-	-
1.09 Number of days to enforce a contract	-	-	-	-

2.01 Availability of latest technologies*	+	+	-	+
2.02 Venture capital availability*	+	+	-	-
2.03 Total tax rate, % profits	-	-	-	-
2.04 Number of days to start a business	+	-	-	-
2.05 Number of procedures to start a business	+	-	-	-
2.06 Intensity of local competition*	+	+	-	-
2.07 Tertiary education gross enrollment rate, %	+	+	-	-
2.08 Quality of management schools*	+	+	-	+
2.09 Government procurement of advanced technology products*	-	+	-	-
3.01 Electricity production, kWh/capita	+	+	-	-
3.02 Mobile network coverage, % population	-	-	-	+
3.03 International Internet bandwidth, kb/s per user	-	-	-	-
3.04 Secure Internet servers per million population	+	-	-	-
3.05 Accessibility of digital content*	+	+	-	+
4.01 Mobile cellular tariffs, PPP \$/min.	-	-	-	-
4.02 Fixed broadband Internet tariffs, PPP \$/month	-	-	-	+
4.03 Internet and telephony sectors competition index, 0–2 (best)	-	-	-	-
5.01 Quality of educational system*	+	+	-	-
5.02 Quality of math and science education*	+	+	-	-
5.03 Secondary education gross enrollment rate, %	+	-	+	+
5.04 Adult literacy rate, %	-	-	+	+
6.01 Mobile phone subscriptions per 100 population	-	-	+	+
6.02 Percentage of individuals using the Internet	+	+	+	+
6.03 Percentage of households with computer	+	+	+	+
6.04 Households with Internet access, %	+	+	+	+
6.05 Fixed broadband Internet subscriptions per 100 population	+	+	+	+
6.06 Mobile broadband Internet subscriptions per 100 population	+	+	-	+
6.07 Use of virtual social networks*	+	+	-	-
7.01 Firm-level technology absorption*	+	+	-	+
7.02 Capacity for innovation*	+	-	-	-
7.03 PCT patent applications per million population	+	-	-	-
7.04 Business-to-business Internet use*g	+	+	-	+
7.05 Business-to-consumer Internet use*g	+	+	-	+
7.06 Extent of staff training*	+	+	-	+
8.01 Importance of ICTs to government vision of the future*	+	+	-	+
8.02 Government Online Service Index, 0–1 (best)	-	+	-	-
8.03 Government success in ICT promotion*	+	+	+	+
9.01 Impact of ICTs on new services and products*	-	-	-	-
9.02 PCT ICT patent applications per million population	+	-	-	-
9.03 Impact of ICTs on new organizational models*	+	+	-	+
9.04 Employment in knowledge-intensive activities, % Workforce	+	+	-	+
10.01 Impact of ICTs on access to basic services*	-	-	-	-
10.02 Internet access in schools*	+	+	-	+
10.03 ICT use and government efficiency*	+	+	-	-
10.04 E-Participation Index, 0–1 (best)	+	-	-	+

The items highlighted with renkli in this table are the sub-indexes ineffective between a country in the Upper middle income group and the countries in other income groups. The '+' sign in the income groups in each sub-index in the table indicates that a country in the Upper middle income group can be raised to an upper group of income when its NRI sub-index value increases. However, a '+' sign in the income group is effective in the fall of a country towards a lower income group than its current group, in the decrease of its related NRI value, and in the fall of a position of a country in the Upper middle income group towards a lower income group. If there is a '-' sign in the income groups then there is no statistically significance and the item is ineffective.

As an example, when the NRI sub-index about the Laws relating to ICTs (1.02) is increased, a country in the Upper middle income group moves in the graph to the High income:Non-OECD ($p=0.001$), High income:OECD

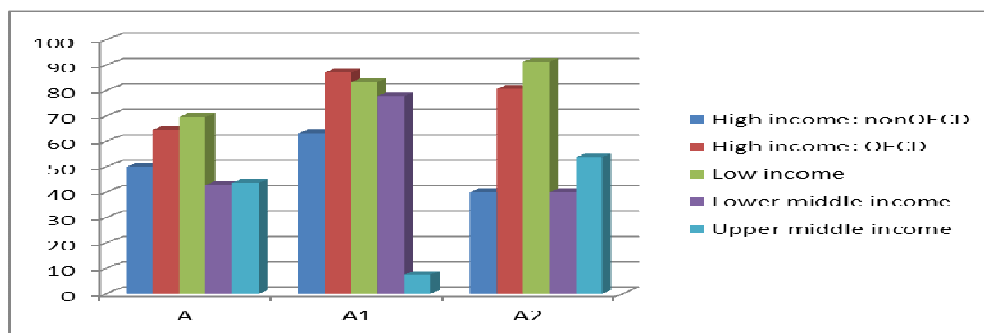
($p < 0.0001$) ($p < 0.001$). However, a decrease in the score of the sub-index 1.02 has no effect in the fall of a country in the Upper middle income group to the low income group. Or, there is no statistically significant difference between the Upper middle income group and other groups in terms of the NRI sub-index on the total tax rate, % profits (2.03), and hence this sub-index is ineffective.

The accuracy rates in the Table 6, Table 7, Table 8, Table 9 and Table 10 were compared by examining each criterion together with their sub-factors. The accuracy rates graphics in the Graph 1, Graph 2, Graph 3, Graph 4 and Graph 5 were compared by examining each criterion together with their sub-factors.

Table 6: Environment Subindex Values

Environment Subindex	A	A1	A2
High income: nonOECD	50	63,2	40
High income: OECD	64,5	87,1	80,6
Low income	69,6	83,3	91,3
Lower middle income	42,9	77,8	40
Upper middle income	43,6	7,4	53,8

Graph 1: Environment Subindex graphic

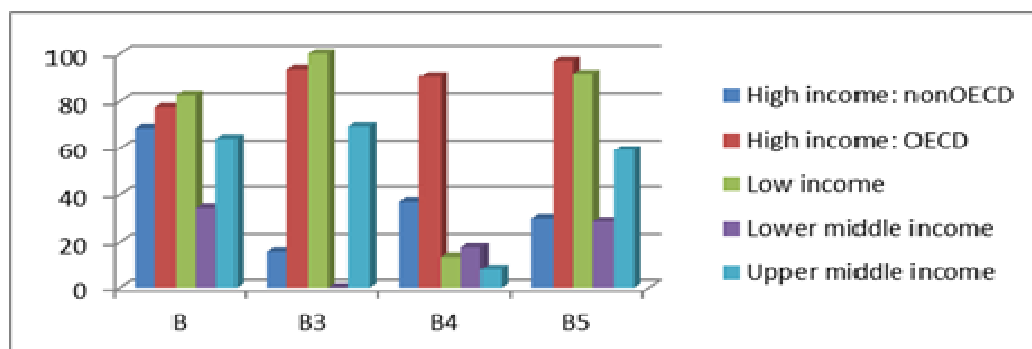


Environment sub-index: Considering the 1/2 political and regulatory environment + 1/2 business and innovation environment criteria (A1-A2 criteria), the Political and regulatory environment criterion (A1) has a higher accuracy rate in explaining the income groups (65.1%).

Table 7. Readiness Sub-index Values

Readiness SubIndex	B	B3	B4	B5
High income: nonOECD	68,4	15,8	36,8	30
High income: OECD	77,4	93,5	90,3	96,8
Low income	82,6	100	13,6	91,3
Lower middle income	34,3	0	17,6	28,6
Upper middle income	64,1	69,2	7,7	59

Graph 2. Readiness Sub-index graph



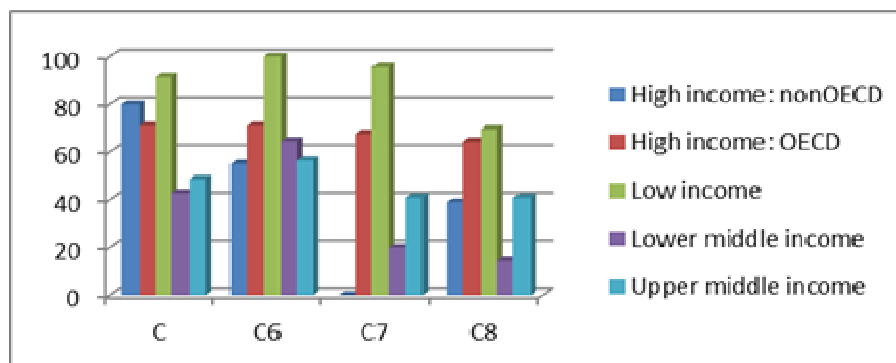
Readiness sub-index: Considering the 1/3 infrastructure and digital content + 1/3 affordability + 1/3 skills criteria (B3-B4-B5 criteria), it has an accuracy rate (63.3%) higher than each of its sub-components. Among

these groups, it explained the most of the variance in the Low income group (82.6%) and the least of the variance in the Lower middle income group (34.3%).

Table 8. Usage Sub-index Values

Usage SubIndex	C	C6	C7	C8
High income: nonOECD	80	55	0	38,9
High income: OECD	71	71	67,7	64,5
Low income	91,3	100	95,7	69,6
Lower middle income	42,9	64,7	20	14,3
Upper middle income	48,7	56,4	41	41

Graph 3. Usage Sub-index graph

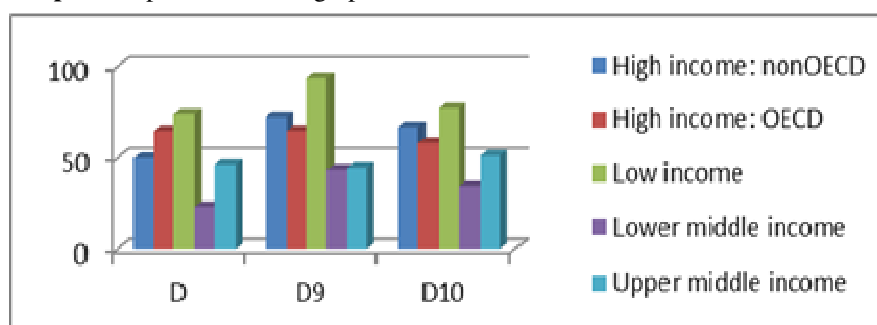


Usage sub-index: Given the 1/3 individual usage + 1/3 business usage + 1/3 governmental usage criteria (C6-C7-C8 criteria), the individual-usage criterion has a higher accuracy rate in explaining the income groups (68.0%).

Table 9. Impact Sub-index Values

Impact SubIndex	D	D9	D10
High income: nonOECD	50	72,2	66,7
High income: OECD	64,5	64,5	58,1
Low income	73,9	93,8	77,3
Lower middle income	22,9	43,3	34,3
Upper middle income	46,2	44,4	51,3

Graph 4. Impact Sub-index graph

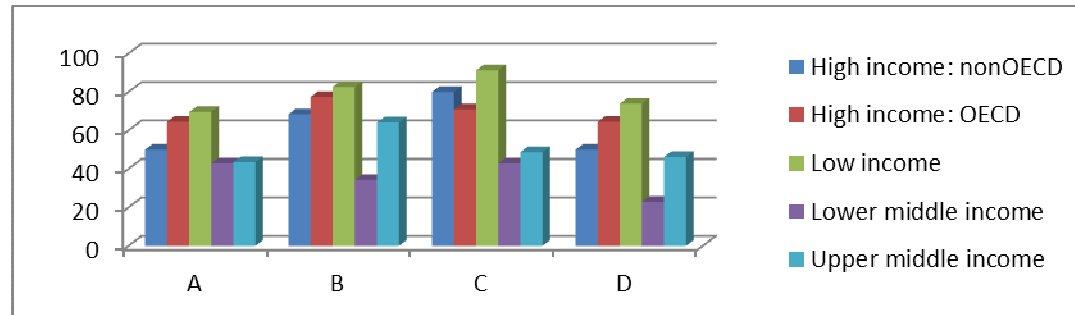


Impacts sub-index: Considering the 1/2 economic impacts + 1/2 social impacts criteria (D9-D10 criteria), the economic-impacts criterion has a higher accuracy rate in explaining the income groups (58.8%).

Table 10. Values of the four NRI groups

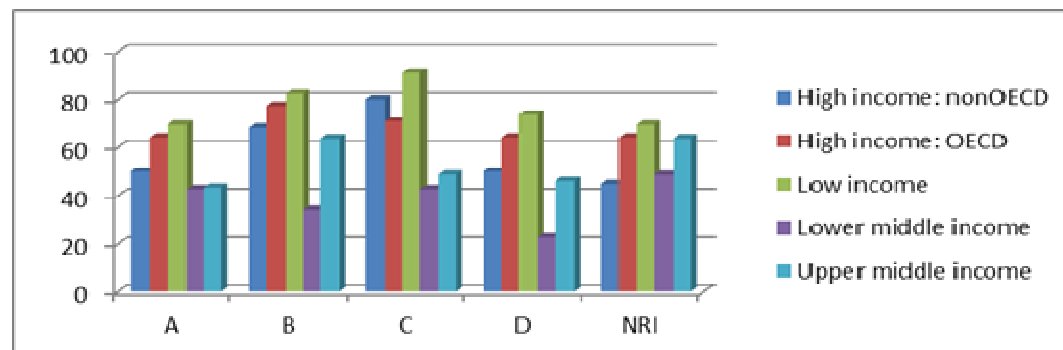
Four Group	A	B	C	D	NRI
High income: nonOECD	50	68,4	80	50	45
High income: OECD	64,5	77,4	71	64,5	64,5
Low income	69,6	82,6	91,3	73,9	69,6
Lower middle income	42,9	34,3	42,9	22,9	48,6
Upper middle income	43,6	64,1	48,7	46,2	64,1

Graph 5. Graph of the four NRI groups



Considering all criteria of the NRI, the highest accuracy rate in explaining the income groups was the Readiness sub-index: 1/3 infrastructure and digital content + 1/3 affordability + 1/3 skills criteria (B) (63.3%). The comparison of the four NRI criteria is given in Graph 6.

Graph 6. The NRI and four NRI sub-indexes graph

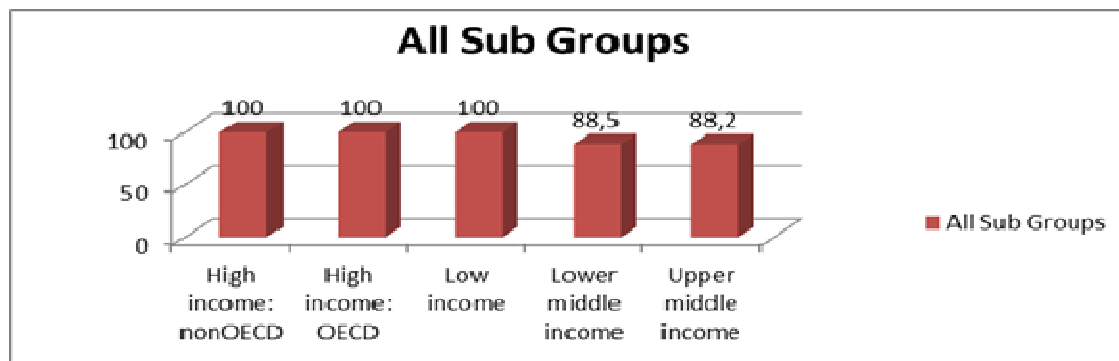


The accuracy rates of all the NRI sub-indexes in explaining the income groups are given in Table 11.

Table 11. The values of the four NRI sub-indexes

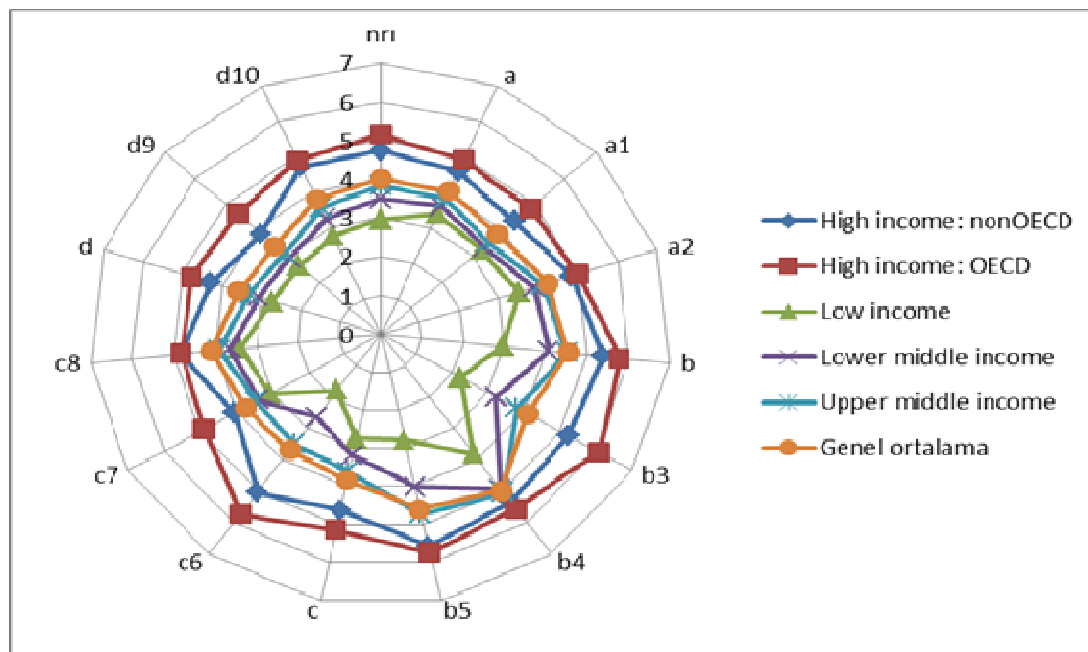
Income Groups	All Subindex groups
High income: nonOECD	100
High income: OECD	100
Low income	100
Lower middle income	88,5
Upper middle income	88,2

Graph 7. The graph of all sub-indexes



The mean values in the descriptive statistic table (Table 12) were used to create the following graph. Here, the NRI, four main indicators, 10 sub-factors and their average income groups are used to create this network graph. By this, the overall average of all income groups and the NRI status relative to each other can be easily identified.

Graph 8. The network graph of all sub-indexes and all income groups.



Looking at the network graph, it is observed that the B4 (Affordability) is high in all countries, and especially in the low income and lower middle income groups this value is higher than the other values. All countries close to each other at the B4. This can be a result of the ineffectiveness of the 4.01 Mobile cellular tariffs, PPP \$min and 4.03 Internet and telephony sectors competition index, 0-2 (best). Mobility is significantly used in all countries in all income groups. The C6 (Individual usage) is where the countries are separated from each other most; it was higher in countries with high income levels, average in the middle income group, and was lower than the average in the low income groups.

The countries in the High income:Non-OECD and High income:OECD groups were very close to each other at the A2 (business and innovation environment), B4 (affordability), B5 (skills), C8 (government usage) and D10 (social impacts). And, they were differentiated at the B3 (infrastructure and digital content), C6 (individual usage), C7 (business usage), D9 (economic impacts). These differences stand out as the characteristic properties that differentiate the High income: Non-OECD and High income: OECD countries from each other.

The Low income B3 (infrastructure and digital content) and the C6 (individual usage) values were lower than the average. The descriptive statistics on all of these criteria and p-values are given in Table 12.

Table 12. Descriptive statistics of (mean \pm SD) NRI and NRI sub-indexes according to the income groups and p-values of the groups

	High income: nonOECD	High income: OECD	Low income	Lower middle income	Upper middle income	p [†]
Nri_2014	4,73 \pm 0,55	5,15 \pm 0,56	2,95 \pm 0,43	3,48 \pm 0,43	3,82 \pm 0,51	<0,0001 [†]
Nri_2013	4,67 \pm 0,56	5,12 \pm 0,58	2,98 \pm 0,38	3,29 \pm 0,72	3,66 \pm 0,75	<0,0001 [†]
Nri2014- Nri2013	0,07 \pm 0,12 (0,024)*	0,04 \pm 0,08 (0,019)*	0,01 \pm 0,16 (0,894)*	0,19 \pm 0,63 (0,082)*	0,17 \pm 0,40 (0,016)*	0,233 [†]
A	4,60\pm0,57	4,92\pm0,55	3,38\pm0,50	3,61\pm0,33	3,82\pm0,53	<0,0001[†]
a1	4,35 \pm 0,66	4,84 \pm 0,77	3,27 \pm 0,64	3,36 \pm 0,43	3,53 \pm 0,62	<0,0001 [†]
a2	4,85 \pm 0,51	5,01 \pm 0,39	3,50 \pm 0,47	3,88 \pm 0,36	4,10 \pm 0,56	<0,0001 [†]
B	5,38 \pm 0,53	5,80 \pm 0,44	2,97 \pm 0,69	4,07 \pm 0,84	4,52 \pm 0,71	<0,0001 [†]
b3	5,24 \pm 0,72	6,07 \pm 0,69	2,21 \pm 0,62	3,23 \pm 0,79	3,79 \pm 0,77	<0,0001 [†]
b4	5,34 \pm 1,16	5,56 \pm 0,69	3,80 \pm 1,71	4,93 \pm 1,42	5,04 \pm 1,17	<0,0001 [†]
b5	5,58 \pm 0,51	5,75 \pm 0,37	2,79 \pm 0,63	4,02 \pm 0,99	4,74 \pm 0,73	<0,0001 [†]
C	4,63 \pm 0,58	5,15 \pm 0,65	2,75 \pm 0,38	3,20 \pm 0,38	3,62 \pm 0,50	<0,0001 [†]
c6	5,03 \pm 0,62	5,73 \pm 0,61	1,77 \pm 0,33	2,63 \pm 0,62	3,51 \pm 0,75	<0,0001 [†]
c7	4,06 \pm 0,63	4,89 \pm 0,84	3,06 \pm 0,35	3,37 \pm 0,32	3,46 \pm 0,43	<0,0001 [†]
c8	4,81 \pm 0,82	4,81 \pm 0,70	3,42 \pm 0,63	3,64 \pm 0,54	3,90 \pm 0,67	<0,0001 [†]
D	4,29 \pm 0,74	4,77 \pm 0,75	2,72 \pm 0,43	3,09 \pm 0,42	3,33 \pm 0,53	<0,0001 [†]
d9	3,87 \pm 0,74	4,63 \pm 0,81	2,64 \pm 0,40	2,93 \pm 0,35	3,09 \pm 0,39	<0,0001 [†]
d10	4,72 \pm 0,83	4,90 \pm 0,79	2,79 \pm 0,50	3,25 \pm 0,52	3,56 \pm 0,71	<0,0001 [†]
1.01	4,11 \pm 0,90	4,25 \pm 0,95	3,31 \pm 0,79	3,37 \pm 0,71	3,32 \pm 0,85	<0,0001 [†]
1.02	4,55 \pm 0,86	4,93 \pm 0,60	3,05 \pm 0,67	3,48 \pm 0,53	3,77 \pm 0,81	<0,0001 [†]
1.03	4,80 \pm 0,94	5,21 \pm 1,17	2,90 \pm 0,80	3,24 \pm 0,78	3,44 \pm 0,94	<0,0001 [†]
1.04	4,33 \pm 0,96	4,41 \pm 1,13	3,36 \pm 0,69	3,45 \pm 0,59	3,55 \pm 0,73	<0,0001 [†]
1.05	4,02 \pm 0,84	4,17 \pm 1,03	3,13 \pm 0,58	3,22 \pm 0,42	3,28 \pm 0,76	<0,0001 [†]
1.06	4,64 \pm 0,93	4,97 \pm 0,83	3,03 \pm 0,66	3,18 \pm 0,56	3,34 \pm 0,81	<0,0001 [†]
1.07	48,26 \pm 15,42	33,84 \pm 12,23	21,67 \pm 39,33	66,11 \pm 32,22	60,62 \pm 24,53	<0,0001 [†]
1.08	39,85 \pm 8,11	31,35 \pm 4,39	38,87 \pm 5,41	39,00 \pm 5,41	37,41 \pm 4,78	<0,0001 [†]
1.09	598,20 \pm 293,56	528,65 \pm 277,43	666,61 \pm 317,88	663,29 \pm 331,15	636,51 \pm 281,87	0,363 [†]
2.01	5,55 \pm 0,62	5,96 \pm 0,53	4,00 \pm 0,67	4,37 \pm 0,56	4,71 \pm 0,65	<0,0001 [†] 1
2.02	3,24 \pm 0,79	3,08 \pm 0,77	2,23 \pm 0,46	2,57 \pm 0,47	2,58 \pm 0,61	<0,0001 [†]
2.03	28,26 \pm 13,15	41,26 \pm 12,13	53,38 \pm 52,54	38,89 \pm 15,64	42,31 \pm 18,62	0,029 [†]
2.04	18,20 \pm 22,33	11,35 \pm 7,64	31,52 \pm 31,18	25,74 \pm 21,23	31,10 \pm 41,52	0,027 [†]
2.05	6,75 \pm 3,14	5,10 \pm 2,26	7,39 \pm 3,47	7,60 \pm 3,20	7,59 \pm 3,68	0,010 [†]
2.06	5,31 \pm 0,54	5,46 \pm 0,41	4,43 \pm 0,52	4,70 \pm 0,48	4,62 \pm 0,74	<0,0001 [†] 1
2.07	49,90 \pm 23,95	70,97 \pm 15,83	7,51 \pm 5,12	22,15 \pm 16,58	38,62 \pm 18,77	<0,0001 [†]
2.08	4,68 \pm 0,61	5,04 \pm 0,69	3,50 \pm 0,59	3,73 \pm 0,75	4,09 \pm 0,72	<0,0001 [†]
2.09	3,86 \pm 0,87	3,69 \pm 0,52	3,25 \pm 0,59	3,34 \pm 0,52	3,35 \pm 0,64	0,002 [†]
3.01	7488,94 \pm 4434,97	10323,22 \pm 9756,66	137,18 \pm 181,92	1496,48 \pm 2149,00	2710,10 \pm 1556,20	<0,0001 [†]
3.02	92,81 \pm 22,94	99,30 \pm 0,87	65,02 \pm 34,53	91,22 \pm 11,18	94,83 \pm 11,07	<0,0001 [†]
3.03	159,42 \pm 333,84	244,05 \pm 718,23	4,42 \pm 5,18	15,33 \pm 22,50	25,05 \pm 24,97	0,031 [†]
3.04	316,83 \pm 385,22	1169,90 \pm 866,52	1,37 \pm 1,20	40,85 \pm 189,31	45,15 \pm 52,54	<0,0001 [†]
3.05	5,79 \pm 0,39	5,98 \pm 0,46	3,69 \pm 0,70	4,56 \pm 0,58	4,74 \pm 0,73	<0,0001 [†]
4.01	0,23 \pm 0,15	0,29 \pm 0,18	0,24 \pm 0,20	0,27 \pm 0,19	0,32 \pm 0,18	0,386 [†]
4.02	32,74 \pm 17,61	30,50 \pm 8,34	210,23 \pm 460,93	50,72 \pm 46,66	35,76 \pm 20,78	0,002 [†]
4.03	1,45 \pm 0,54	1,93 \pm 0,12	1,38 \pm 0,61	1,56 \pm 0,55	1,61 \pm 0,48	0,001 [†]
5.01	4,37 \pm 0,85	4,47 \pm 0,82	3,22 \pm 0,61	3,43 \pm 0,71	3,41 \pm 0,76	<0,0001 [†] 1
5.02	4,78 \pm 0,85	4,71 \pm 0,65	3,34 \pm 0,53	3,59 \pm 0,79	3,76 \pm 0,96	<0,0001 [†]
5.03	83,09 \pm 33,00	105,97 \pm 11,11	38,77 \pm 14,35	69,91 \pm 21,36	85,64 \pm 15,84	<0,0001 [†]
5.04	90,56 \pm 21,73	98,85 \pm 0,79	58,98 \pm 18,12	80,13 \pm 15,38	91,00 \pm 9,54	<0,0001 [†]

6.01	142,85±33,89	121,91±21,05	55,87±27,92	96,51±26,83	115,99±32,08	<0,0001 [†]
6.02	68,31±11,55	80,41±11,04	6,69±7,18	23,91±14,34	41,85±16,48	<0,0001 [†]
6.03	73,46±10,74	81,23±10,34	4,33±2,64	19,39±13,16	38,20±18,53	<0,0001 [†]
6.04	66,15±13,35	79,65±12,51	3,50±2,34	15,24±11,89	33,57±17,92	<0,0001 [†]
6.05	16,48±8,85	28,24±7,58	0,10±0,16	2,59±3,14	7,70±5,23	<0,0001 [†]
6.06	47,61±29,39	64,93±24,97	4,00±7,46	9,06±9,84	19,37±16,39	<0,0001 [†]
6.07	6,05±0,33	6,10±0,36	4,53±0,56	5,22±0,51	5,52±0,56	<0,0001 [†]
7.01	5,24±0,59	5,51±0,58	4,03±0,51	4,37±0,47	4,57±0,58	<0,0001 [†]
7.02	3,75±0,62	4,64±0,79	3,03±0,43	3,31±0,46	3,37±0,51	<0,0001 [†]
7.03	10,95±27,63	118,81±93,94	0,01±0,05	1,14±4,35	2,40±4,59	<0,0001 [†]
7.04	5,33±0,51	5,60±0,48	4,12±0,52	4,50±0,50	4,63±0,64	<0,0001 [†]
7.05	4,91±0,54	5,48±0,51	3,45±0,52	4,04±0,60	4,29±0,75	<0,0001 [†]
7.06	4,36±0,52	4,57±0,64	3,42±0,52	3,77±0,48	3,86±0,52	<0,0001 [†]
8.01	4,57±0,95	4,29±0,70	3,71±0,69	3,66±0,73	3,77±0,77	<0,0001 [†]
8.02	0,63±0,22	0,76±0,15	0,25±0,12	0,37±0,14	0,47±0,17	<0,0001 [†]
8.03	4,85±0,86	4,46±1,00	4,09±0,71	4,02±0,64	4,11±0,68	0,001 [†]
9.01	4,71±0,63	5,04±0,58	3,79±0,57	5,08±6,27	4,16±0,60	0,431 [†]
9.02	3,69±11,86	34,07±33,07	0,00±0,00	0,09±0,19	0,62±1,42	<0,0001 [†]
9.03	4,56±0,62	4,79±0,58	3,53±0,55	3,82±0,54	3,96±0,62	<0,0001 [†]
9.04	31,93±8,61	39,96±8,02	3,56±4,45	14,55±10,02	19,65±9,33	<0,0001 [†]
10.01	5,00±0,75	5,11±0,66	3,50±0,59	12,41±50,91	4,88±5,81	0,625 [†]
10.02	5,37±0,64	5,60±0,76	2,73±0,79	3,49±0,80	3,91±0,92	<0,0001 [†]
10.03	4,78±0,85	4,68±0,66	3,60±0,69	3,79±0,63	3,94±0,76	<0,0001 [†]
10.04	0,39±0,28	0,52±0,28	0,05±0,08	0,16±0,17	0,24±0,22	<0,0001 [†]
All	-	-	-	-	-	<0,0001 [#]

*:Paired t testi p değeri, #:MANOVA p değeri, †:ANOVA p değeri

The all pairwise comparisons between the groups were statistically significant, according to NRI 2013 and NRI 2014 indexes ($p < 0.05$).

For the differences between NRI 2014 and NRI 2013, paired t-test for dependent groups was used in the analysis. The difference between NRI 2014 and NRI 2013 was statistically significant in terms of the High income: Non-OECD group. The difference between NRI 2014 and NRI 2013 was also statistically significant in terms of the High income:OECD group. And also, the difference between NRI 2014 and NRI 2013 was also statistically significant in terms of the Upper middle income group. There was no statistically significant difference between the groups in terms of the new variables obtained by subtracting the NRI 2013 values from the NRI 2014 values of all countries ($p = 0.233$). However, the indexes were not changed in the low income (0.01 ± 0.16) (0.894)* and lower middle income (0.19 ± 0.63) (0.082)* groups in terms of the differences between NRI 2014 and NRI 2013 values, therefore the difference between 2014 and 2013 was not significant.

And, the differences between groups in terms of the environment sub-index (political and regulatory environment, business and innovation environment), the readiness sub-index (infrastructure and digital content, affordability, skills), the usage sub-index (individual usage, business usage, governmental usage), the impacts sub-index (economic impacts, social impacts) criteria were significant at least the $p < 0.05$ level. In addition, there were no significant difference between the income groups in 7 NRI sub-items: Number of days to enforce a contract (1.09), the total tax rate, % profits (2.03), international Internet bandwidth, KB/s per user (3.03), mobile cellular tariffs, PPP \$/min. (4.01), Internet and telephony sectors competition index, 0-2 (best) (4.03), impact of ICTs on new services and products (9.01), impacts of ICTs on access to basic services (10.01). According to these criteria, there was no statistically significant difference between the Upper middle income group and other groups.

And, after incorporating all the variables into the model, there was a statistically significant difference between the groups according to MANOVA (multivariate analysis of variance) analysis results ($p < 0.001$).

6. Conclusion And Discussion

Progress in the technology and informatics continue to increase at a dazzling speed each passing day and affect

us in every area of life. The internet and information technologies have made our world smaller, globalized and removed the boundaries between countries in competition. Not money or natural sources but the information technology has become the most important competitive factor in businesses, as the world globalizes rapidly. Information technologies are formal information systems that utilize various sources to collect, process, store and report the information necessary for managers to make decisions (Tekin et al., 2000: 83). According to Nomura (2002:263-278), the information systems owned by businesses have become one of the traditional business resources such as land and capital, and these systems are now the backbone of modern business enterprises (Collier, 2009: 148).

NRI is a performance analysis on the use of information technologies in a country and hence is a strong index that comparatively measures level of readiness of countries to use Information and Communication Technologies (ICTs). The first data set, which was obtained from the findings from the Executive Opinion Survey prepared for the Global Competitiveness Report, shows the importance of the NRI in the competition between countries in terms of the ICTs. Although it has no direct economic items, it has very good sub-items in explaining the income groups of countries. Considering all subgroup values of the NRI, the accuracy rate in explaining the income groups was found to be 94.0%. The NRI is able to differentiate the High income:Non-OECD - High income:OECD- Low income (%100), Lower middle income (%88.5) and the Upper middle income (%88.2) groups correctly. And, when all the components were incorporated into the model, it was found that it is significantly correlated with the High income:Non-OECD - High income:OECD - Low income group countries (100%), and able to fully explain the income groups of these countries. The accuracy rate was found to be 94.0% in explaining the income groups of the countries when all sub-index values of the NRI were taken into account with the help of the discriminant functions which can be formed in accordance with the findings of the study.

The comparison of the NRI 2013 and the NRI 2014 values provided very good clues. Here, it was observed that the change in the NRI was not very fast. The fastest lower middle income group is the group with the highest standard deviation and variation between countries. The NRI variation is lowest in the High income:OECD group countries. Low income group decreased by 0.03 in 2014 compared to 2013. The resulting decline was not statistically significant.

Territorial map also provided important findings. According to the map, the Upper middle income group is located in the center of the graph and has borders with all groups. In the territorial map, the direction of an average country, i.e. a country in the Upper middle income group, was found depending on the change in the NRI; that is to say, it is possible to know whether a country in the Upper middle income group moves towards the upper income group or towards the lower income group by looking its NRI value change. In addition, it is easy to identify the impossible income groups for a country by looking at the NRI values in the map. For example, a country in the lower middle income cannot move to the high income:OECD group. Likewise, a country in the High income:Non-OECD group cannot fall to the low income group.

The overall average of all income groups and the NRI status relative to each other can be easily identified in the network graph created by using the NRI, 4 main indicators, 10 sub-factors and their average income groups or in the created by using the mean values in the descriptive statistics table (Table 11). Here, it is possible to see clearly the extent of effectiveness of the NRI sub-indexes in the income groups and the NRI sub-indexes common or different between the countries.

Looking at the network graph, it is observed that the B4 (Affordability) is high in all countries, and especially in the low income and lower middle income groups this value is higher than the other values. All countries close to each other at the B4. This can be a result of the ineffectiveness of the 4.01 Mobile cellular tariffs, PPP \$min and 4.03 Internet and telephony sectors competition index, 0-2 (best). Mobility is significantly used in all countries in all income groups. The C6 (Individual usage) is where the countries are separated from each other most; it was higher in countries with high income levels, average in the middle income group, and was lower than the average in the low income groups.

The countries in the High income:Non-OECD and High income:OECD groups were very close to each other at the A2 (business and innovation environment), B4 (affordability), B5 (skills), C8 (government usage) and D10 (social impacts). And, they were differentiated at the B3 (infrastructure and digital content), C6 (individual usage), C7 (business usage), D9 (economic impacts). These differences stand out as the characteristic properties that differentiate the High income:Non-OECD and High income:OECD countries from each other.

The Low income B3 (infrastructure and digital content) and the C6 (individual usage) values were lower than the average.

Although the NRI has a very successful distinctive power to differentiate countries depending on their income

levels, however, there were no significant difference between the income groups in 7 NRI sub-items: Number of days to enforce a contract (1.09), the total tax rate, % profits (2.03), international Internet bandwidth, KB/s per user (3.03), mobile cellular tariffs, PPP \$/min. (4.01), Internet and telephony sectors competition index, 0-2 (best) (4.03), impact of ICTs on new services and products (9.01), impacts of ICTs on access to basic services (10.01). According to these criteria, there was no statistically significant difference between the Upper middle income group and other groups. These sub-indexes do not have any discriminatory power and they are ineffective. Although they are ineffective for 2014, these sub-indexes may be effective in the subsequent years. That is, there was no statistically significant difference between the values obtained for the year 2013 and 2014 in the study. This result shows us the significance of these values will change gradually in the subsequent years.

Information and Communication Technologies (ICTs) lead to positive developments in the organizations, management, productivity, and hence the welfare of countries. Regarding this positive impact, it is important to analyze and identify the position of countries accurately in terms of ICT indexes, which is an important factor for companies, and hence the countries, to achieve their targets by acquiring a sustainable competitive advantage.

In order to increase the income-levels of countries, it is very important for governments to know how to benefit from the NRI, which is a performance analysis on the use of information technologies in a country and hence is a strong index that comparatively measures level of preparedness of countries to use Information and Communication Technologies (ICTs). According to the results of the study, the countries need to plan their priority NRI factors well to raise their income groups, improve their competitiveness and welfare. Considering the numerous indexes in the literature, we think that the policy makers of the countries, senior managers of businesses, leading IT specialists shaping the IT industry and management information systems specialists need to analyze the NRI well.

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